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Hooded Booms for Grape Spraying

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Sprayer with Adjustable Hood Open and Operating in Vineyard.

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BULLETIN No. 732

HOODED BOOMS FOR GRAPE SPRAYING

E. F. TASCHENBERG[1]

INTRODUCTION

EXPERIMENTS begun in 1940 have proved the value of hoods and of improved spray units in the control of the grape berry moth and of grape leafhoppers in vineyards in the Great Lakes area where wind frequently interferes with thoro spraying of the vines. This bulletin describes improvements in the booms and hoods covering the booms to reduce the effects of wind during spraying operations. Details of construction are presented to enable grape growers to build their own outfits, as few are being made commercially.

FIG. 1.—Rigid hood in operation.

[1] Acknowledgment is made to Mr. Elmer C. Thies of the Thies Welding Company, Fredonia, N. Y., for his assistance and ideas on construction of the collapsible hood and the adjustable hood. Thanks are also due Professor F. Z. Hartzell for his cooperation and assistance on the manuscript and C. V. Flagg, County Agricultural Agent for Chautauqua County, for taking a number of the photographs.

It should be noted that with all the outfits described both sides of the grape row are sprayed at the same time. For clarity, it seems advisable to consider hoods first and follow with a discussion of spray booms. The hoods are described as "rigid", "hinged", "collapsible", and "adjustable", and the advantages and disadvantages of each are noted. The cost and complexity of construction increase from the rather simple, rigid type to the adjustable type.

INTRODUCTION AND IMPROVEMENTS IN HOODS

Wind interference was the main difficulty in applying the grape sprays effectively. The introduction of hoods reduced the effects of the wind on the spray (Figs. 1 and 2). These outfits envelop the vines while the treatment is being made. Furthermore, nozzle discs, having smaller apertures than is practical without hoods, may be used, thus making it possible to apply a more finely atomized spray.

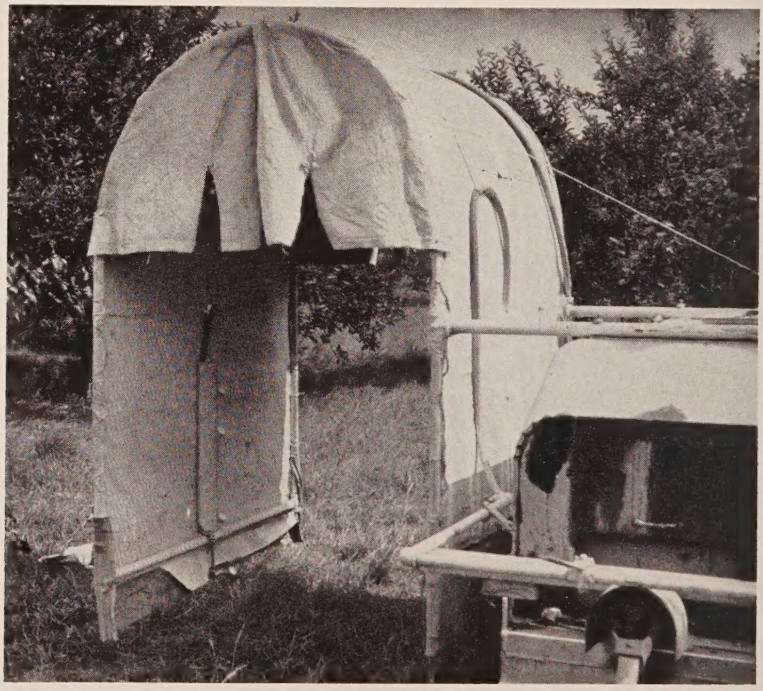

Fig. 2.—Rigid hood and type A spray unit. Note fur-farm netting used to support cover.

Apparently the covered boom has been used for a number of years by nurserymen in Michigan for spraying nursery stock.[2] In 1933 or 1934, W. F. Johnson[3] observed grape sprays being applied under hoods in Missouri vineyards. J. G. Woodman[4] of Van Buren County, Mich. constructed and used a covered boom about 1935. Since that time much interest has developed in the use of this accessory spraying equipment, which has now appeared in the principal grape-growing areas of the Great Lakes region. According to Hutson (4)[5] the hood used in the experimental work in Michigan was a "U"-shaped piece of metal sheeting that was attached to the frame of the sprayer. Since 1940 the hoods have consisted of frames covered with canvas.

RIGID AND HINGED HOODS

One of the first hoods used in Chautauqua County was constructed during May, 1940. This homemade outfit was built by J. A. Merritt[6] with the assistant of E. H. Phillips[7] and the writer, being practically the same as the one shown in Figs. 1 and 2. The rigid frame constructed of 1-inch pipe (Fig. 3), being neither adjustable nor collapsible, was covered with canvas. In 1941, the Robey Manufacturing Company, East Lansing, Mich., built and sold a hood similar to the one shown in Figs. 1 and 2.

The advantages of the rigid hood are (a) low cost of construction, (b) simplicity, (c) efficiency, and (d) sturdiness. The lower cost is due to the fact that the outfit can be made on the farm with a minimum of skilled labor. As will be noted in Figs. 3 and 6, numerous holes must be drilled in the pipes, clamps, flat iron, and sprayer frame so a drill press of some kind will be needed. No welding, however, will be required. A number of growers have built these hoods from second-hand pipe that had sufficient strength at a considerable saving over new material.

The disadvantages of the rigid hood are that (a) the frame is rigid and heavy thus making it difficult to remove or replace by one man, (b) the outfit will not pass thru narrow lanes or other restricted passage-ways, (c) it is not adjustable in width, (d) it is not collapsible

[2] Correspondence from Dr. Ray Hutson, Head, Entomology Department, Michigan State College, East Lansing, Mich.

[3] At that time County Agricultural Agent, Van Buren County, Michigan.

[4] Later County Agricultural Agent, Van Buren County, Mich.

[5] Numbers in parenthesis refer to Literature Cited, page 34.

[6] Tobacco By-Products and Chemical Corp., Louisville, Ky.

[7] G. L. F., Ithaca, N. Y.

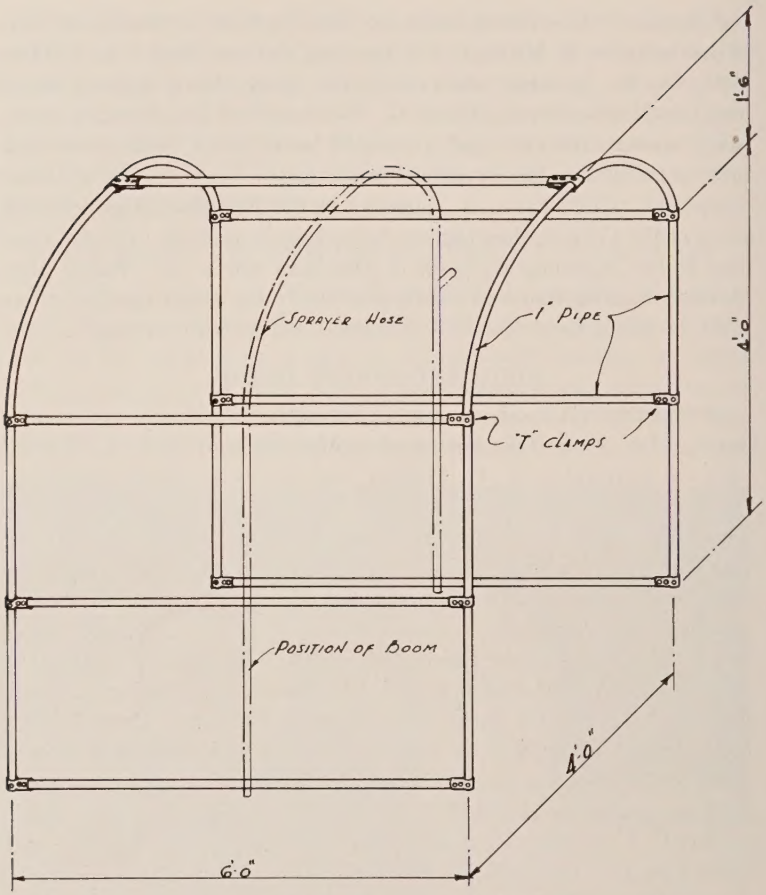

Fig. 3.—Details of frame for rigid hood.

so requires more room for turning at the ends of the rows and considerable storage floor area, and (e) it cannot be operated on rows having obstructions such as very high posts and telephone or other poles without the assistance of an extra man and with considerable labor and loss of time.

In the vineyards on the south shore of Lake Erie, when the rows of grapes are perpendicular to the highways, it is customary to place the poles of rural telephone and low-voltage electric lines next to end posts of the grape trellis. This is done, by mutual agreement between

the companies and the land owners, in order that such poles will not interfere with the implements used in removing pruned brush, cultivating the vines, maintaining the trellis, and harvesting the crop. Occasionally, the lines may cross a vineyard some distance from the ends of the rows. In such instances, the poles are set in the trellis rows for the same reasons.

The hinged hood is simply a rigid hood with a hinge which permits the frame to be laid on top of the spray tank to pass obstructions, to travel in restricted passage-ways, and to store the entire spray outfit on less floor area without removing the hood from the sprayer. A commercial hinged hood was made and sold in 1942 by G. F. Hales, Port Washington, Wis. The bare frame, attached to a sprayer is shown in Fig. 4. It will be noted that the lower tie-pipe passes thru two bearings fastened to the ends of the pipes which constitute the supporting frame. Two chains hold the hood frame in an upright position. Of all the hoods described in this bulletin, this will pass an obstruction, such

FIG. 4.—Commercial hinged hood equipped with type A spray units. This hood frame is hinged to the supporting frame and is held vertically by means of chain stays. Canvas cover removed to show construction of frame and spray units.

as a telephone pole, more quickly than other kinds, because, without removing a bolt, it can be easily laid on the top of the sprayer and after the pole has been passed the hood can be swung over the vines. In 1941, a grape grower[8] converted his homemade rigid hood into a hinged hood by placing a hinge (Fig. 5) on the inner side of each end frame.

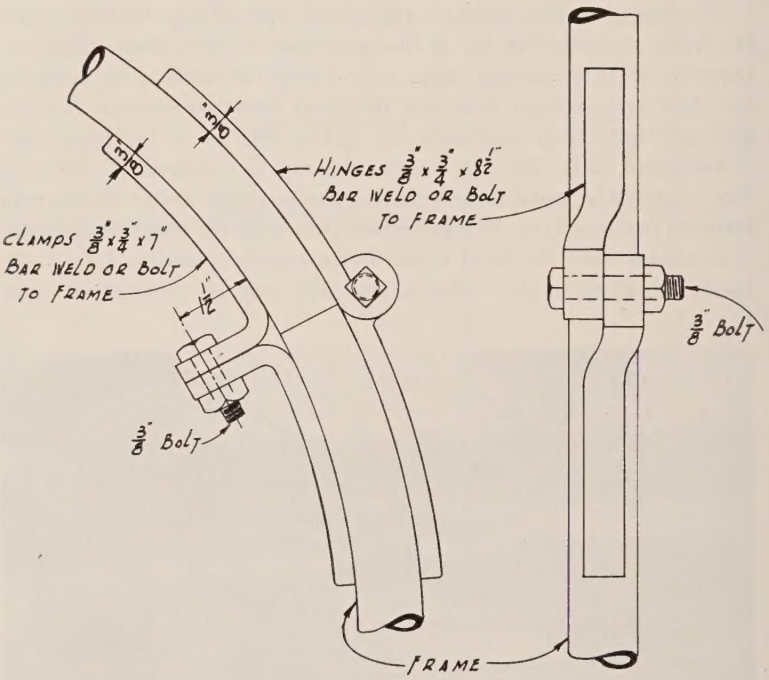

FIG. 5.—Details of hinge used to convert a rigid hood to a hinged hood.

The hinge removes all the objectionable features of the rigid hood except one; *viz.*, it is not adjustable in width. It will retain all the advantages of the preceding type except that the cost will be increased. A blacksmith will be required to make the hinge, but welding can be avoided by the use of bolts to fasten the hinge to the frame. If welding is desired, it would also increase the cost. Since this hinge, by the removal of two bolts (Fig. 5), allows the top and outer portion of the frame to be laid on top of the sprayer tank, the following advantages

[8] Frank Palmer, Westfield, N. Y.

are secured over the rigid hood: (a) Use in narrow passage-ways, on roads, and with less space for turning at the ends of the grape rows, (b) the sprayer can be stored in a space sufficiently wide for an ordinary vehicle, and (c) obstructions in the grape row can be easily passed. In fact, an obstruction can be passed more easily and quickly than with any other type of hood described here, except the one made by F. G. Hales (Fig. 4). For this reason, the grower who has many obstructions in the grape rows and limited space for turning at the ends will find the hinged hood a very desirable one to use.

DETAILS OF CONSTRUCTION

Frame.—The details for construction of a homemade rigid hood frame are shown in Fig. 3. Each end frame or U is formed by bending a piece of 1-inch pipe, 13 feet, 8 inches long, so as to make a center height 5½ feet and the width 4 feet. The seven tie-pieces or ribs are 6-foot lengths of 1-inch pipe. These ribs are connected to the end U's either by clamps, having sockets which accommodate the ends of the ribs, or by pipe clamps. If the latter are used, two bolts ⅜-inch by 2 inches fasten the clamps on each end of the tie pipes. In order to hold these ribs in position the clamps should be bolted to the end frame. In the early stages of development the frame was covered with "fur farm" netting of about 2-inch mesh to prevent the canvas from sagging when it became soaked with spray (Fig. 2). This difficulty may also be overcome by using four hardwood slats 6 feet, 4 inches long, 2½ inches wide and ⅝ inch thick which may be fitted lengthwise on the hood frame and held in place by U-bolts.

The hinged hood is similar to the rigid hood in all respects except that the frame is hinged. This hood may be hinged as indicated in Fig. 5 to facilitate transportation as well as for tilting the hood in a vineyard where occasional power-line or telephone poles are found. By using hinges, the extended part of the hood may be laid over and allowed to rest on the top of the spray tank. The end frames or U's are cut on the inner side, that is, the side next to the sprayer. The exact position for hinging cannot be given because this will vary with the height of the spray tank and location of the hood supports. Before determining the place for the hinges it should be noted that the top of the hood must rest firmly on top of the spray tank. Furthermore, the outside of the hood should project upward in a nearly vertical position. Details for making the hinges and stops are given in Fig. 5. It will be

noted that two ⅜-inch bolts must be removed in order to swing the frame on the hinges.

Supports.—These rigid and hinged hoods may be supported on the spray rig by four pieces of 1-inch pipe (Fig. 6). Two long pieces of pipe, the length depending on the width of the tank, are bolted crosswise on the top of the tank, if the tank is at least 6 feet long, and attached to the end frames of the hood by pipe clamps. With tanks less than 6 feet in length a special construction would be necessary to sup-

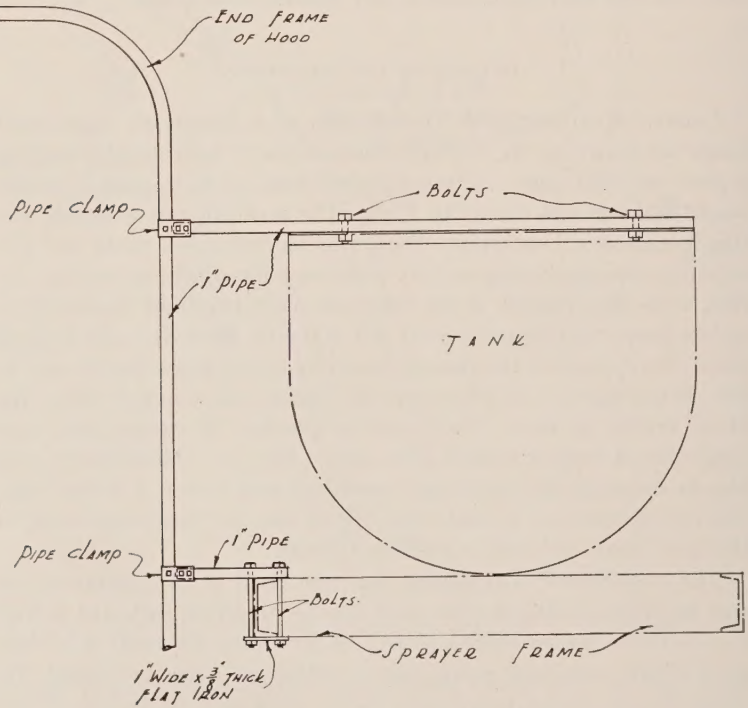

FIG. 6.—Details of support for rigid or hinged hoods.

port one of these crosspipes and this would depend on the kind of spray machine used. The short pieces are bolted to the bed of the sprayer and clamped to the lower part of each end frame. All clamps are fastened to the hood frame and supporting pipes by ⅜-inch bolts. The bottom of the hood should be 18 inches above the surface of the soil.

All the supporting pipes should be long enough so that the inner side of the hood is outside of the wheel with a clearance of at least 3 inches.

Cover.—For both hoods, the frame is covered by one piece of canvas — No. 10 waterproof duck — 15 feet long and 6 feet wide. Grommets, or metal eyelets, are spaced 15 inches apart on the ends and sides of the cover. Pieces of sash cord 15 inches long are used to tie the cover to the hood frame.

The front end curtains used at the top of the frame are made of two pieces of canvas 2½ feet long (bottom) and 2 feet wide (side). Each cloth is cut to conform to the bend in one-half of the frame (Fig. 2). Metal eyelets are placed every 6 inches along the curve of the top and one in the center of the side. Each half of the curtain is tied in six places to the top of the hood frame and once on the side. The free edges should overlap along a vertical line from the center of the hood. These free edges should never be tied because the high posts cannot pass thru without damaging the curtains.

The short rear curtains are made exactly the same as those in front except that there is no grommet on the end next to the vertical part of the hood frame. The long rear curtains are 5½ feet long and 16 inches wide. These are fitted with grommets about 6 inches apart at the top and about 1 foot apart on the outer side. The top of each is shaped to fit the frame and each overlaps the short curtains by 16 inches horizontally. These long curtains are necessary to prevent air currents affecting the spray.

COLLAPSIBLE HOOD

The collapsible hood (Fig. 7) was developed by the writer and E. C. Thies[9] in 1941 in order (a) to assemble it quickly for operation in vineyards and to disassemble the hood for movement on the highways, and (b) to eliminate excess weight without sacrificing strength. A tubular-truss construction was used which had sufficient durability to withstand extensive operation for six seasons without breaking. It was replaced by the adjustable hood described later only because the latter had various mechanical advantages. The experimental plots used by the author were scattered for a distance of between 20 and 30 miles, hence the necessity for an outfit which could be quickly mounted or dismantled. Heavy auto traffic precluded traveling on the highways

[9] Thies Welding Company, Fredonia, N. Y.

FIG. 7.—Collapsible hood constructed for use on truck bed and type B spray unit. Note support above tank for outer spray boom.

unless the width of the sprayer and hood did not exceed that of regular vehicles.

The advantages of the collapsible hood are (a) the frame is light, sturdy, and durable; (b) it is easily assembled and dismantled by one man; (c) it can be quickly lifted from its supports and allowed to remain in the vineyard if necessary to pass thru narrow passage-ways for refilling the tank; (d) in passing a high obstruction, the hood can be removed and replaced rather quickly, altho this is rather awkward for one man; (e) the hood can be stowed on the sprayer without collapsing for traveling on highways or in narrow passage-ways; and (f) for storage, the hood can be dismantled and thus occupies little space in farm buildings.

The disadvantages are that (a) the hood is more expensive to construct than the rigid or hinged hoods, mainly because of the amount of welding necessary; (b) it is not adjustable in width; (c) altho the outfit is light, it is rather inconvenient for one man to handle either for passing an obstruction or in stowing for transportation; and (d) it requires considerable time for erecting and for dismantling, and as much room for turning at the ends of the grape rows as with the rigid hood, unless the hood is removed while turning the spray rig which is impracticable unless rows of several sections are in line so that the machine can be driven long distances before turning.

DETAILS OF CONSTRUCTION

Frame.—Probably most grape growers who wish to construct a trussed frame will prefer the adjustable hood. Lest some, however, may desire to construct a collapsible hood because of its lower cost, suggestions for making it are given here. The reader should first study the construction of the adjustable hood (pages 15 to 19). No drawings are given for the collapsible hood because by modifying the details shown in Figs. 10 to 12 no additional plans seem necessary. The first decision the builder must make is whether the hood is to be used on a regular vineyard spray rig similar to the one shown in Fig. 4 (not including the hood frame shown) or with a sprayer mounted on the bed of a 1½-ton truck (Fig. 7).

Assuming first that it is to be used on a regular sprayer, both bottoms of each end frame should be about 18 inches above ground. Thus, both sides would be built according to the specifications of the right half of the frame shown in Fig. 10. The upper arch would require a ⅜-inch pipe 16 feet long and the inner pipe would be 14⅓ feet, each bent as shown. The trussing is continued on the left side the same as on the right, and all contacts are to be welded. The spray unit could be attached to the side farthest from the machine as shown but should be separate from the frame if it is desired to vary the width between the spraying units. The curtain rod could be omitted if desired and the curtains shaped and tied to the lower arch as shown in Fig. 7. The remainder of the hood frame construction is the same as described for the adjustable hood.

If the hood is to be used on a truck with the bed 44 inches high, as shown in Fig. 7, then the inner side of the end frame would be 26 inches shorter than the outer side. In this event, the upper arch would require a pipe 13 feet, 10 inches, long and the pipe for the lower arch would be 12 feet, 2 inches, long. The ends of the two pipes would be welded together the same as shown for the outer portion (Fig. 10).

Supports.—On an ordinary vineyard sprayer, the supports would be the same as for the rigid hood (Fig. 6), except that the pipe clamps should be modified in such a manner that the part attached to the hood would be flattened so as to bear on both pipes of the hood frame at each of the four points of attachment. The flat part could be attached by bolts or by welding. If the hood is built for use on a truck, then two supports should be fastened on the bed. Each could consist of a piece of angle iron, 40 inches in length, bent to a right angle at the middle

with a brace connecting the two ends. In the angle there should be welded a small rectangular socket in which the stub end of the hood frame rests. A bolt and flat piece of iron attached near the top of the support will hold the hood in position. Each support should be bolted to the bed of the truck.

Cover.—If used on a regular vineyard sprayer, the canvas cover should extend to the bottom of the frame on each side. This would require a canvas 6 feet wide by 14 feet, 4 inches, long. For use on a truck, the curtain on one side need reach only to the truck bed because the bed frame and chassis prevents wind interference. The size would be 6 feet wide by 12 feet, 2 inches, in length. In order to use an adjustable boom the curtain should be slit vertically on the side nearer the sprayer.

The end curtains could be the same as for the adjustable hood, the dimensions of which are given in Fig. 14. If the end curtain rods were omitted, then the tops of the curtains would be cut to fit the lower arch and would be tied with sash cord (Fig. 7).

ADJUSTABLE HOOD

The adjustable hood (frontispiece and Fig. 8) was devised by the writer and E. C. Thies in 1946 to avoid the necessity of dismantling and especially to allow adjustments to be made quickly and easily for varying widths of vine growth in vineyards, and for spraying such small fruits as currants and raspberries. The outfit can be easily opened or closed. The frame is sturdy and fairly light.

The three chief advantages of the adjustable hood over any other described here are that (a) it can be adjusted in width to accommodate different conditions of vine growth, as well as for currants and raspberries; (b) it can be opened for operation and closed to allow passage in narrow places, for transportation on highways, for turning at the ends of the grape rows, and for storage by sliding the movable portion of the hood on the horizontal track; and (c) the amount of time required for these changes is measured in seconds, thus saving much time over that required for the collapsible hood. Other advantages are that it can be easily detached from the spray machine by removing two bolts and disconnecting the feed lines. The latter operation can be done by one man, altho this is somewhat inconvenient, and it can be stored in practically the same space as the sprayer without dismantling. The frame is fairly light, sturdy and durable. It is the most efficient and has the lowest operating cost of all the hoods mentioned.

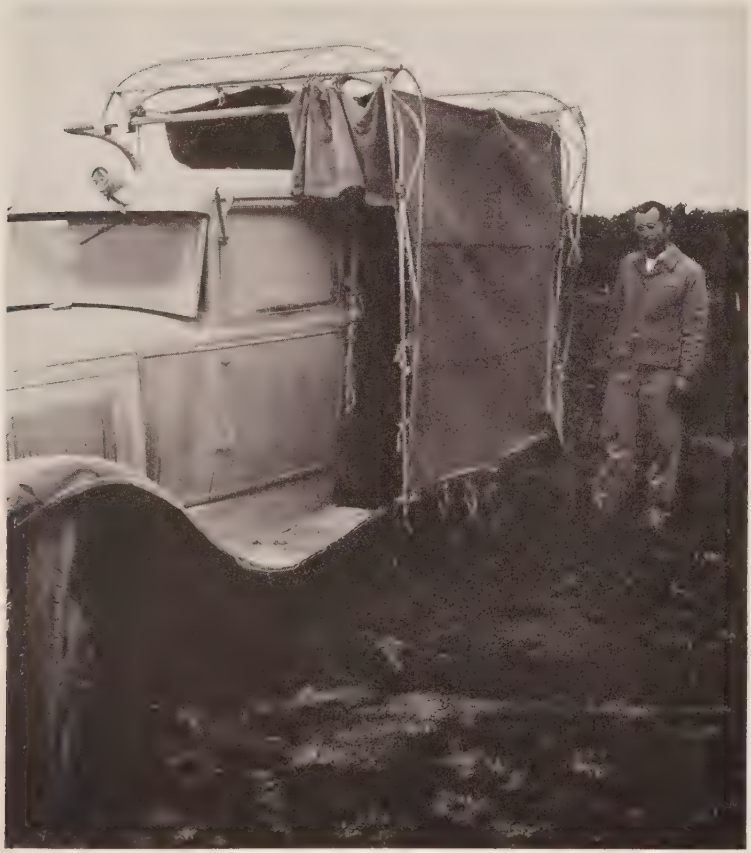

FIG. 8.—Adjustable hood closed for movement outside of vineyard.

The disadvantages are that (a) it is the most expensive type to construct, altho the cost is not excessive; and (b) it is as inconvenient as the collapsible hood for passing high obstructions in the row.

DETAILS OF CONSTRUCTION

Frame.—A perspective drawing of this hood frame is given in Fig. 9 and construction details are shown in Figs. 10 to 13. The frame is made of ⅜-inch pipe and ⅜-inch trussing rods. Each end frame of the

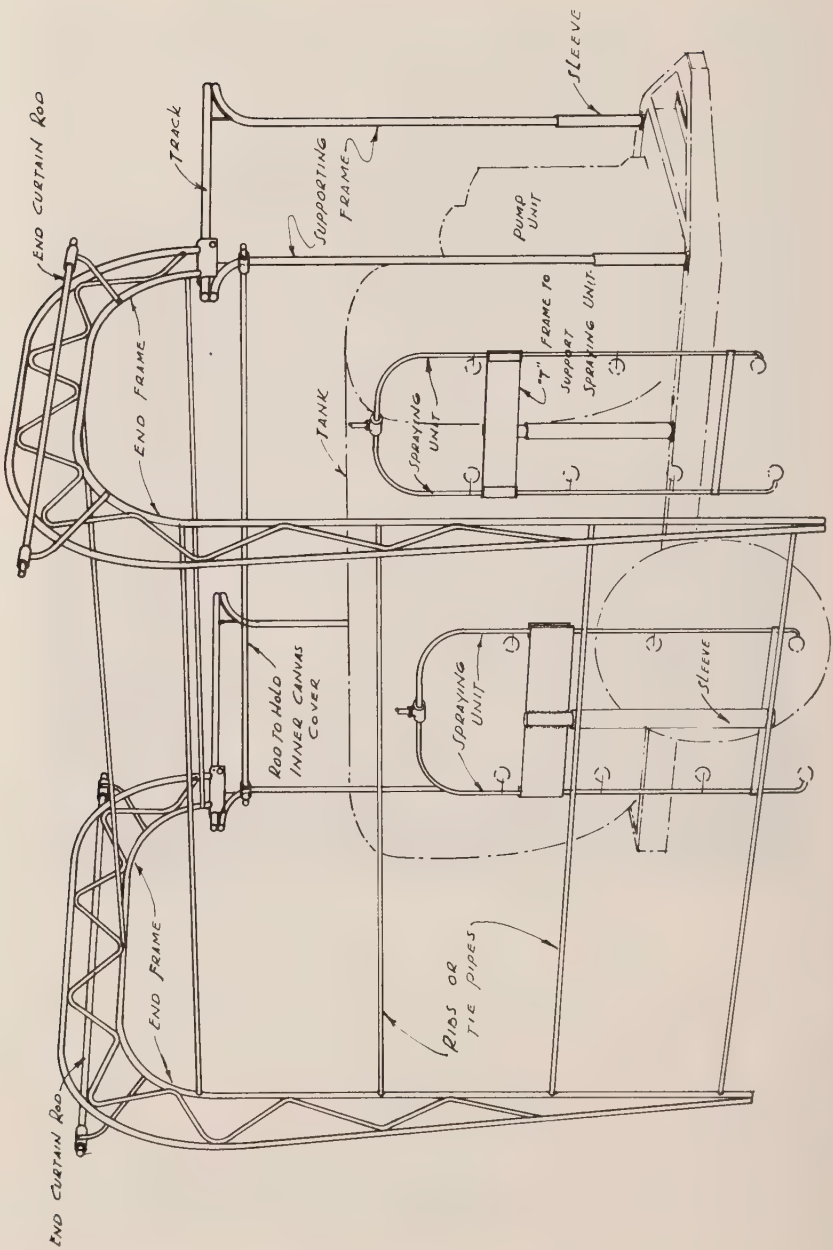

FIG. 9.—Perspective view showing construction and supports of adjustable hood and type B spray units.

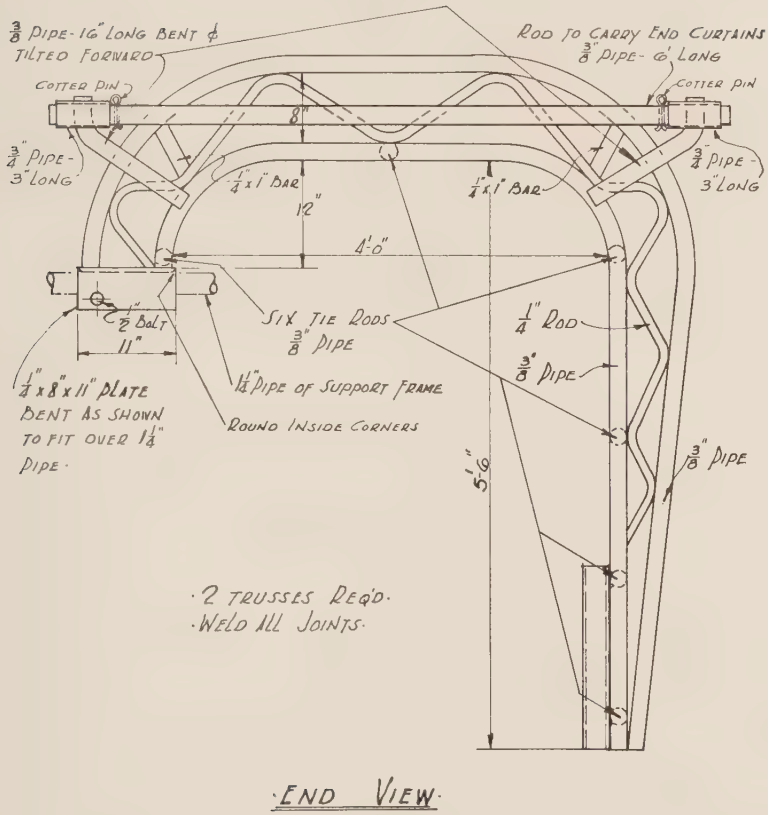

FIG. 10. Details of end frame for adjustable hood. (The trussing rod shown as ¼ inch in diameter should be ⅜ inch.)

hood consists of an outer pipe 11 feet, 6 inches, long, and a lower pipe 9 feet, 10 inches, long, all bent as shown. The ends on the longer side are welded together (Fig. 12). A trussing, formed by bending a ⅜-inch rod, is welded to the upper and lower pieces where contact is made. Each bend of the end frame is reinforced by a piece of flat iron 1 inch wide and ¼ inch thick (Fig. 10). These pieces are welded in place. On the short or "stub" side of the end frames the tips or ends of the upper and lower pieces are welded to a "yoke" (Fig. 10). Each yoke is prepared by bending to a U shape a piece of iron plate, ¼-inch thick, 8 inches by 11 inches. When shaped the yoke is 11 inches long and

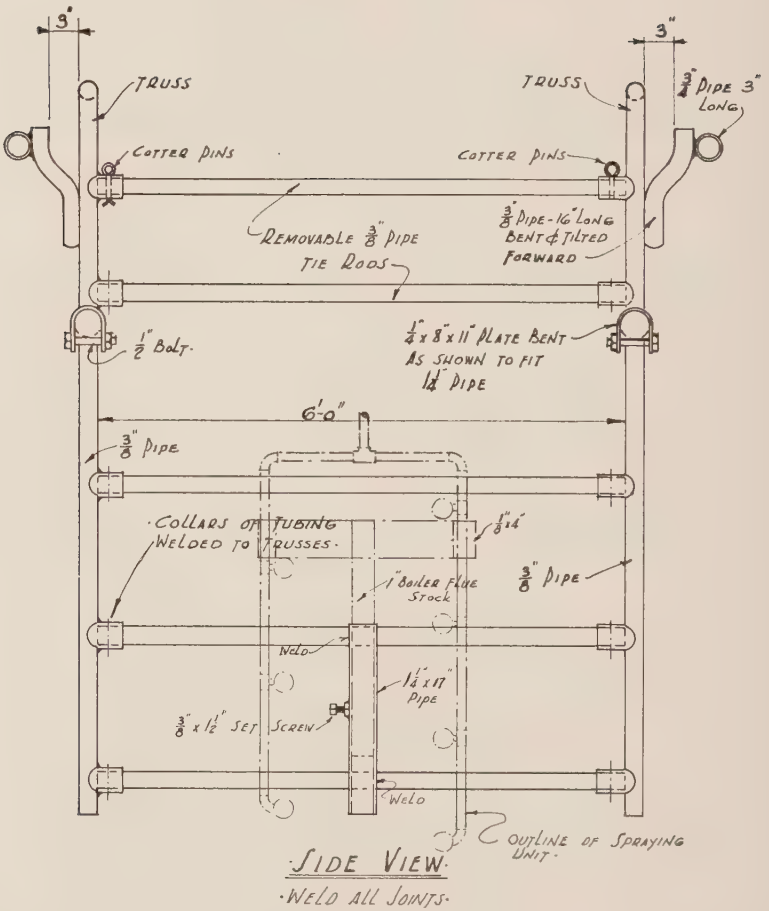

Fig. 11.—Details of side of adjustable hood.

will slide freely on a 1¼-inch pipe of the support. A bolt, ½ inch by 3 inches, holds each yoke in position on the supporting frame. Six closed collars or sockets are welded to the lower piece of each end frame (Figs. 11 and 12). Each collar accommodates the end of the tie pipe or rib. These are held in place by cotter pins. The six tie-pipes are pieces of ⅜-inch pipe 6 feet long.

The front and rear curtains are held by pieces of ⅜-inch pipe, 6 feet long. These end curtain rods are supported by brackets which are

shaped and welded to the end of the frames as shown in Figs. 9 to 11. Each brace is made by welding a 3-inch collar of ¾-inch pipe to the end of a 16-inch piece of ⅜-inch pipe (Fig. 10).

Supports.—Definite specifications for constructing a support for the hood frame on every sprayer cannot be given. Most of the information on this problem is offered here as suggestions. The general plans that are presented for building the hood support were found to be practical as well as adaptable to several makes of spray rigs.

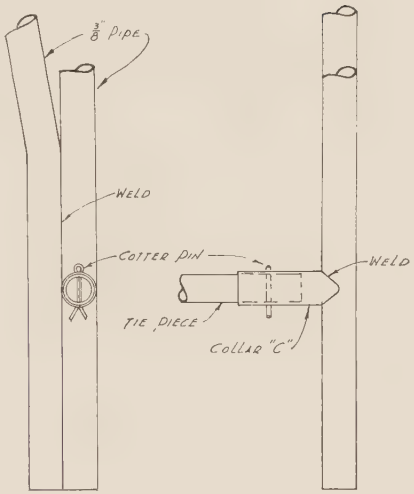

FIG. 12.—Details of sockets for tie pipes of collapsible and adjustable hoods. Note ends of arches are welded together.

Before the construction is undertaken the following points should be considered: (a) the width of the spray tank as well as the tread of the wheels, (b) the height of the frame of the sprayer from the ground, (c) the taper of the fore part of the sprayer frame, and (d) the possible interference of hood supports with the operation and repairing of the engine or pump. The outer side of the hood frame should be 18 inches above the ground. Also, a support that might appear to be sufficiently strong in the shop may prove insecure in the vineyard due largely to vibrations and possible collisions with posts.

The placement of the sleeves which hold the supporting frame of the hood on the sprayer is determined by the position of the spraying unit on the inner side. The support of this spraying unit is mounted ahead of the wheels on the frame of the sprayer. There should be a clearance of at least 3 inches between the back row of nozzles of the spraying unit and the wheel. Also, the front end of the hood is extended 2 feet beyond the front row of nozzles.

The supporting structure for this adjustable hood consists of two frames which are held in position by sleeves on the frame of the sprayer, as shown in Fig. 13. Each frame is made of two pieces of 1-inch pipe, called uprights, whose length depends on the type of sprayer; and

a horizontal track or slide of 1¼-inch pipe, 4 feet long, on which the yoke of the hood travels. The uprights are welded to the slide. In the case of narrow outfits, it will be necessary to curve the end of each upright outwards to accommodate the slide. The joints at which the track and uprights meet may be reinforced, as shown in Fig. 13. Pieces of ⅜-inch flat iron 6 inches long are used for this purpose. One side of each piece is cut to fit the curve of the upright. Also, these pieces serve as stops for the hood when opened the full width. These supporting frames may be made more rigid by using ⅜-inch rod in an X-type of bracing between the uprights. However, this type of bracing is not suitable for all sprayers because it may interfere with the opening on the top of the tank. This problem may be overcome by bracing the sleeves for the uprights to the frame of the sprayer. There are four of these sleeves. Each sleeve is made of a piece of 1½-inch pipe 15

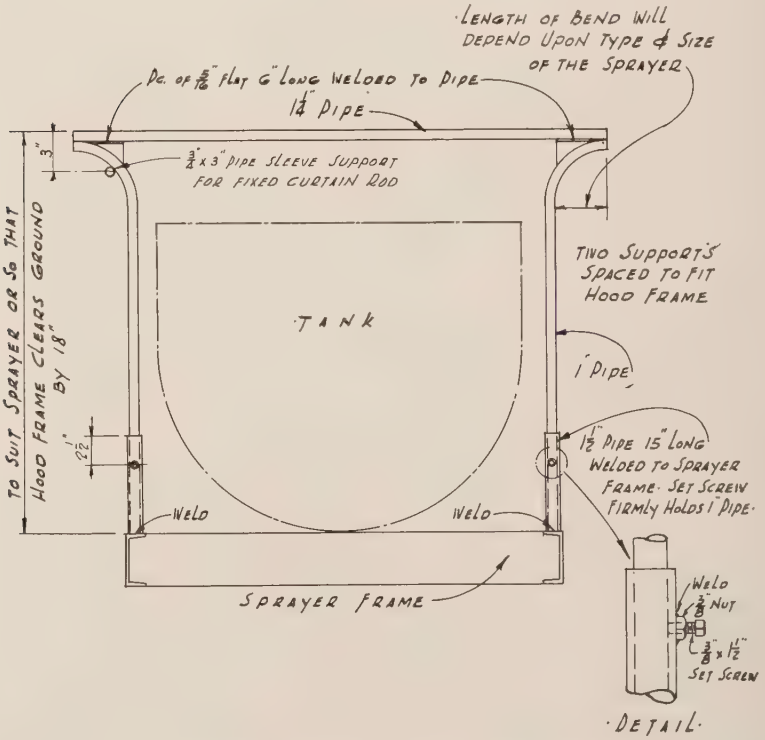
LENGTH OF BEND WILL DEPEND UPON TYPE & SIZE OF THE SPRAYER
PC. OF 5/16" FLAT 6" LONG WELDED TO PIPE
1¼" PIPE
3"
¾" x 3" PIPE SLEEVE SUPPORT FOR FIXED CURTAIN ROD
TO SUIT SPRAYER OR SO THAT HOOD FRAME CLEARS GROUND BY 18"
TWO SUPPORTS SPACED TO FIT HOOD FRAME
TANK
1" PIPE
2½"
1½" PIPE 15" LONG WELDED TO SPRAYER FRAME. SET SCREW FIRMLY HOLDS 1" PIPE.
WELD
WELD
SPRAYER FRAME
WELD
⅜" NUT
⅜" x 1½" SET SCREW
DETAIL.

Fig. 13.—Details of support for frame of adjustable hood.

inches long equipped with a set screw (Fig. 13). The tightener consists of a ⅜-inch set screw 1½ inches long and a ⅜-inch nut. The nut is welded over a $^{7}/_{16}$-inch hole which is 2½ inches from one end of the sleeve.

A piece of ⅜-inch pipe 6½ feet long — the side curtain rod — and two collars of ¾-inch pipe 3 inches long hold the inner side of the hood cover in position. These collars are welded on the inner uprights of the two frames at a distance of 3 inches from the horizontal track (Fig. 9). This ⅜-inch pipe is held in place by two cotter pins.

Cover.—Two pieces of canvas, No. 10 waterproof duck — are required to complete the hood cover. The piece of canvas for the top and side of the hood frame is 12½ feet long and 6 feet wide. Metal eyelets are spaced every 12 inches on one end (bottom of hood) and along 10 feet of each side (front and rear of hood). The canvas is tied to the bottom rib and to the lower U of the hood frame with sash cord. The above length includes an extra 2 feet of canvas which serve as a hanging curtain to close the longitudinal gap between the top of the hood frame and the fixed inner curtain. Furthermore, this long flap is advantageous when the hood is operated at a width of less than 4 feet. The other piece of canvas is 6 feet long and 4½ feet wide and is used to cover the inner side of the hood. Both ends and the top of the cover have grommets every 12 inches. This canvas is tied to the inner uprights of the supporting frames of the hood and to the lengthwise curtain rod which connects these uprights.

End curtains that will not injure the new growth make the hood more effective by preventing the wind currents from passing thru it The curtains may be made of canvas of the same weight as the hood cover.

The front curtains are made of two pieces of canvas 2½ feet square. A metal eyelet is placed in the center of one side so the curtain can be tied to the side of the hood frame. Along an adjacent side, six grommets are equally spaced. A 1¼-inch ring is tied in each grommet, as shown in Fig. 14. The purpose of the rings is to allow the curtain to slide along the pipe which supports it across the front end of the hood frame.

The rear end of the hood frame is covered by a pair of curtains (Fig. 14), each half of which is made up from two pieces of canvas, one a 2½-foot square (the inner piece) and the other 18 inches by 6 feet (the outer piece). One end of the longer piece is sewed to a side

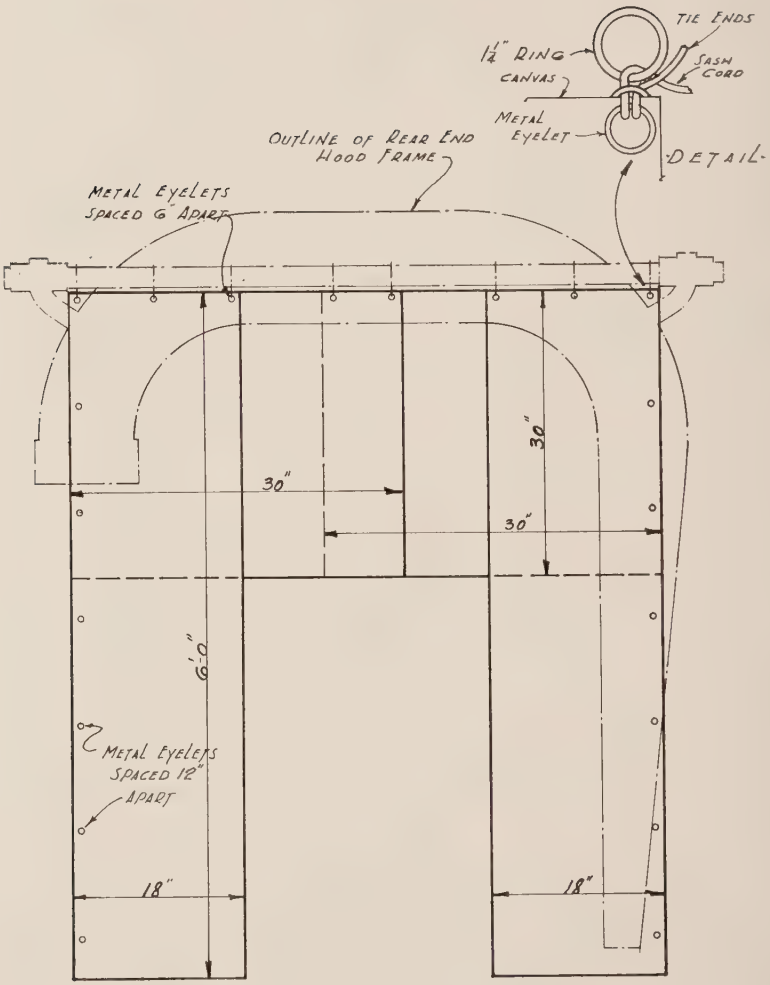

Fig. 14.—Details of end curtains.

of the shorter. Grommets are spaced 6 inches apart thru both curtains along this end, the top, and every 12 inches on only the outer edge of the long piece. The long curtains are tied in place, but the sides of the short pieces are never tied. These curtains are suspended from a rod by metal rings in the same manner as described for the front pair.

"VORTICAL" SPRAYING

The idea of using a U-shaped boom for treating both sides of the vineyard row in one operation apparently originated with Mulford D. Buskirk of Paw Paw, Mich.[10] He constructed an inverted U-type boom, as illustrated in Fig. 15. Since application on both sides of the

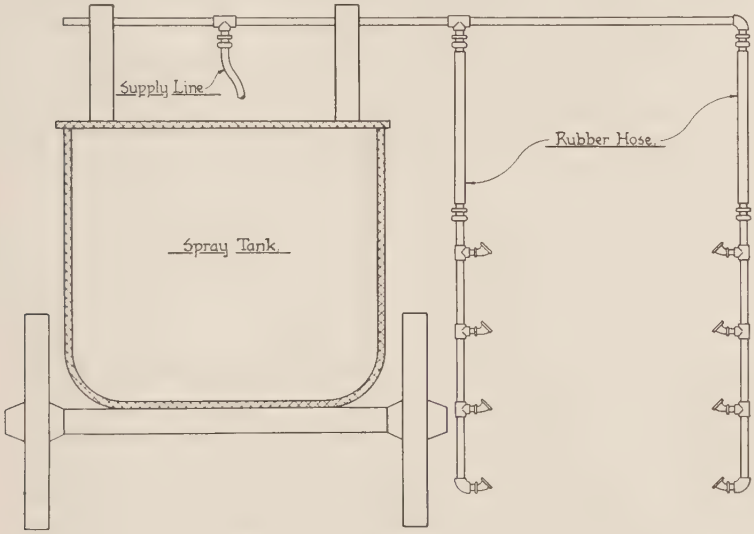

FIG. 15.—Inverted U boom introduced by M. D. Buskirk.

row at the same time causes the spray to swirl and thus cover the undersides of the foliage and fruit better than spraying each side of the row separately, this method is designated as "vortical" spraying.

The Buskirk boom had certain defects, the chief being that, with variation in pressure, the pipes carrying the nozzles assumed different angles, thus changing the direction of the spray. This occurred because each vertical pipe was suspended from the horizontal feed line by a piece of hose to prevent breakage. Some growers were able to overcome this deficiency partially by placing a narrow strip of wood from the top to the bottom of each spraying unit. De Long (1) attempted to eliminate this tendency by placing a weight on the bottom of each vertical spraying unit. Another disadvantage of this U boom was the lack of a means for adjusting the width between the two verti-

[10] Personal communication from F. Z. Hartzell.

cal parts especially to prevent the nozzles from catching in the shoots and foliage where the trellis row was wide.

It is necessary at this point to define certain terms for clarity in descriptions. The term "spray boom", or more briefly, "boom", refers to the rigid construction whereby the nozzles are held in proper relation to the vines as regards height and width and includes the "spray units". The latter is the part of the boom which carries the nozzles. "Inner boom" refers to the portion of the boom which carries the nozzles nearest the spray rig, while "outer boom" refers to the portion with the nozzles farthest from the spray rig. It should be noted that in the rigid, hinged, and adjustable hoods the booms are actually combined with the hood. In the collapsible hood the boom is entirely separate from the hood.

IMPROVEMENTS IN SPRAY BOOMS

To overcome certain defects of the Buskirk boom and at the same time secure vortical spraying, a modified boom (Fig. 16) was devised by field workers of the United States Bureau of Entomology at Sandusky, Ohio. Eyer and McCubbin (2) and Gilliam (3) present the details for constructing this equipment. The inner nozzle arrangement was supported from the side of the spray tank by a hinged inner boom and was held in the correct spraying position by a spring and stop. A supporting frame fastened to the top of the spray tank carried the horizontal feed line to which was attached the outer boom. This support permitted the feed line to be raised quickly by hand in case it was necessary to pass an obstruction, such as a very high post or a telephone pole.

More important was the fact that the outer spray unit could be adjusted horizontally to compensate for variation in driving and breadth of vines due to vigor of growth or type of training. Since this outer spraying unit was rigidly attached to the feed line, except for the lower nozzle which was attached by a short piece of hose to prevent breaking, the direction of the spray was not altered by changes in the pressure. From the time that Buskirk developed the U boom to the present, all improvements in nozzle arrangements have made use of the principle of vortical spraying.

The principle of spray booms described in the preceding paragraph has been followed by the author, *viz.*, a more or less rigid inner boom and an outer boom which is adjustable as regards width. The improvements have consisted of devices for quickly changing the heights of the spray units.

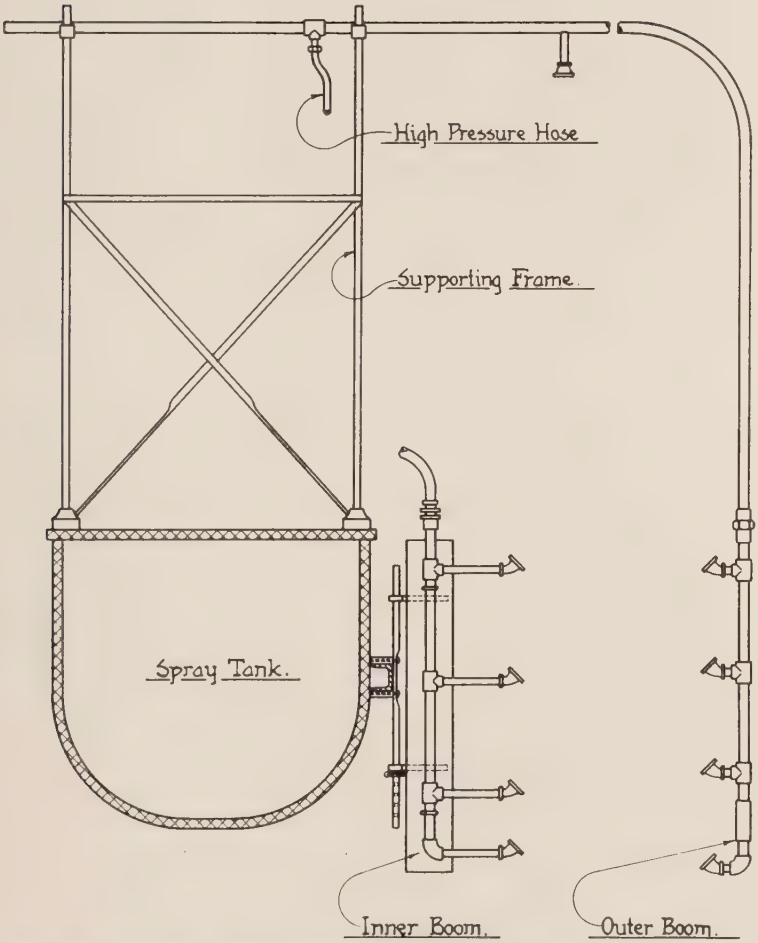

FIG. 16.—Inverted U boom developed by United States Bureau of Entomology.

ADJUSTMENT IN HEIGHT

The spray units could be raised and lowered in the rigid and hinged hoods, but this was a tedious operation because they were attached to the frame by means of U-bolts, the threads of which became corroded due to the continual wetting by the spray. With the collapsible hood, the spray units were carried entirely by the inner and outer booms

(Fig. 9). With the collapsible hood the height of the units was adjusted on the supports by means of a set screw, operated by a handle instead of a wrench. This had the following disadvantages: (a) As the sliding parts became coated with spray materials, adjustments were made with difficulty; (b) when the feed line to the outer boom accidentally was slightly bent near the support, horizontal operation was hindered; and (c) the support was a part separate from the hood. The height of the farther unit was adjusted on the support by means of a set screw operated by a handle instead of a wrench (Fig. 7).

An improved method for adjusting the height of the spray units was designed and used with the adjustable hood. (See page 31.)

ADJUSTMENT IN WIDTH

The booms used on the rigid and hinged hoods were not adjustable in width between the two spraying units. The spraying units used with the collapsible and adjustable hoods were adjustable in width, being entirely separate from the hood in the former type but with the outer spray unit attached to the side of the hood farthest from the sprayer in the latter (Fig. 9). In the latter arrangement the adjustment in width for spraying is accomplished by changing the width of the hood. The general principle of the spray booms used with the collapsible hood is the same as shown in Fig. 16, one improvement being the use of spray units such as shown in Fig. 18. With the collapsible hood, the spray unit farthest from the sprayer was adjusted in width by sliding the horizontal portion of the boom. A part of this support and the horizontal pipe are shown in Fig. 7. A hand-operated set screw in the support enabled the operator to fasten the boom at any desired width.

SPRAY UNITS

The spray units used with the rigid and hinged hoods are adaptations of those of the Buskirk U-boom (Figs. 2, 3, 4, and 17), using four or five nozzles on a side, all in a vertical row. This arrangement does not cover the fruit sufficiently for the best control of the grape berry moth. The writer modified these units in the collapsible and adjustable hoods by using two vertical pipes on each side with four nozzles in the front column and three nozzles in the rear column, all staggered vertically (Figs. 7, 9, 11, and 18). The advantages of the latter design compared with the single row of four or five nozzles on a side are that (a) the nozzles can be arranged so as to point the spray from a greater

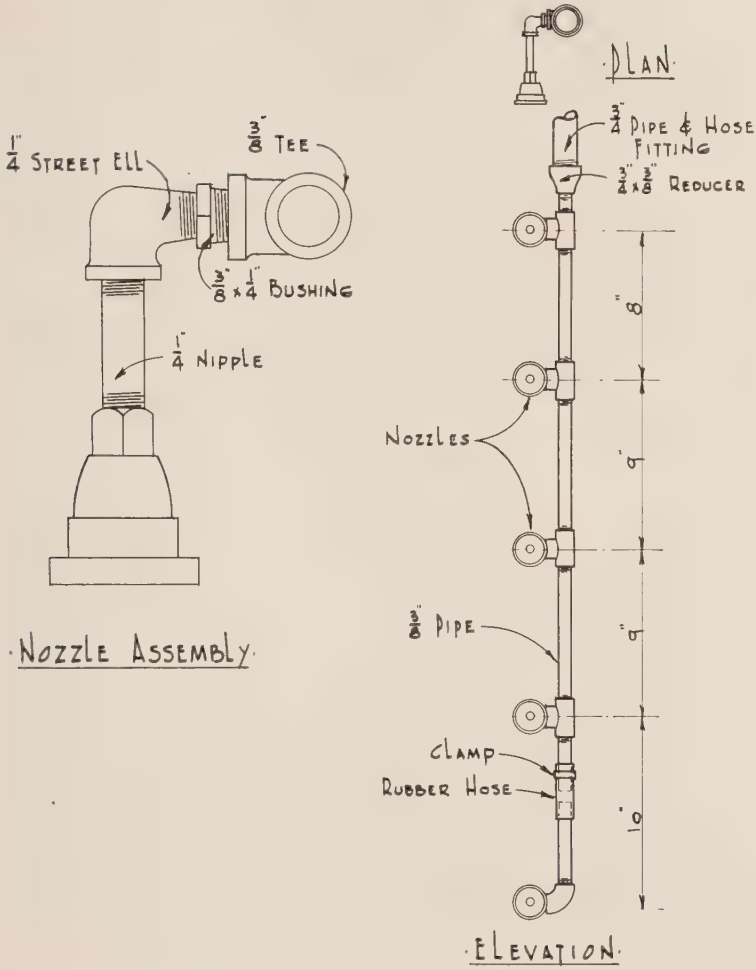

FIG. 17.—Details of type A spray unit.

number of directions without the spray cones[11] interfering; (b) the amount of swirling motion is increased; (c) the nozzles can be fitted with discs having smaller apertures than when only four or five nozzles are used, thus giving a more misty spray without increasing the

[11] "Cones" as used here refers to the shape the spray assumes after leaving the nozzle.

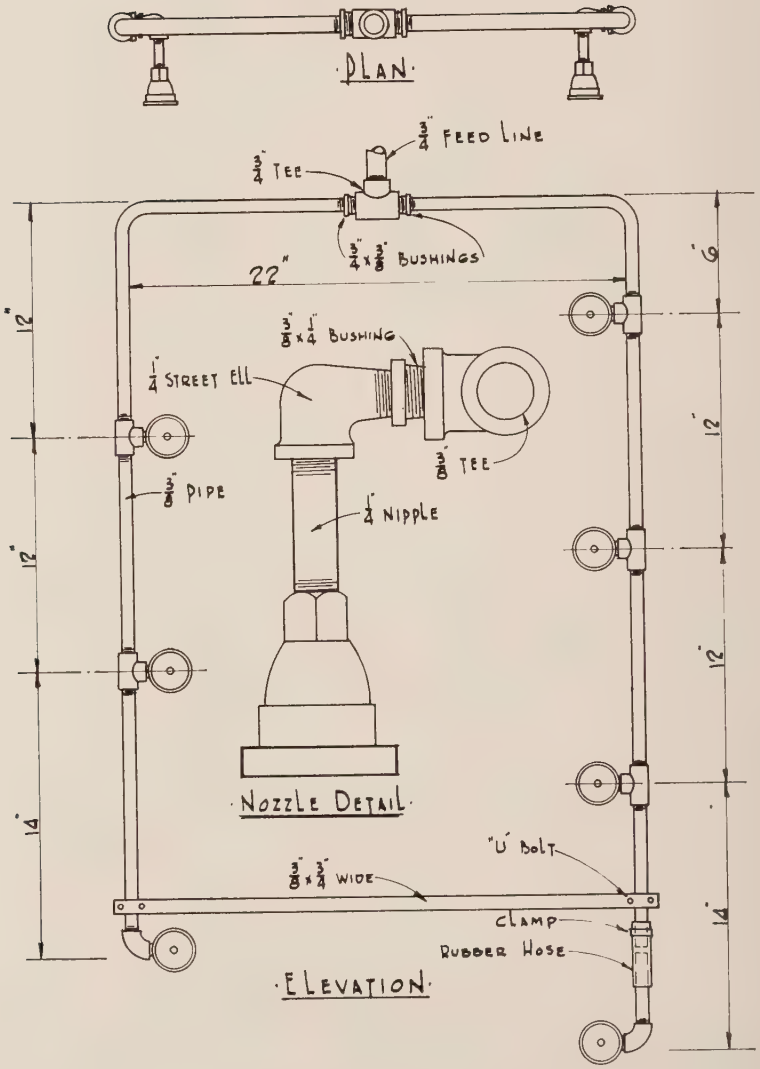

FIG. 18.—Details of type B spray unit. The bar shown as 3/8" x 3/4" wide should be 3/16" x 3/4" wide.

volume; and (d) the spray from the front set of nozzles tends to raise and turn the leaves, thereby enabling the rear set to cover many clusters and the undersides of leaves more thoroly.

CONSTRUCTION OF SPRAY UNITS

It should be remembered that either of the spray units and any of the supports can be used with each of the four types of hoods. That certain spray booms or units are illustrated with particular hoods is due to the fact that improvements on both types of equipment were being made at the same time. This, however, is no reason for restricting a given boom or spray unit to any one type of hood. In discussing the construction of spray booms, it is necessary, for clarity, to consider separately spray units, supports, and location of the units. For brevity of reference the two kinds of spray units will be designated as A and B. In the A type, the unit consists of four or five nozzles in a vertical column on each side of the grape row (Figs. 4 and 17). The B type of spray unit consists of seven nozzles on each side of the grape row, set in two columns about 22 inches apart, with four nozzles in the front column and three in the rear column, staggered in height with respect to the front column (Figs. 7 and 18).

TYPE A SPRAY UNIT

Although this unit is not as efficient for control of the grape berry moth as the type B unit, some grape growers may wish to construct it, so directions for making it are given here. The details of this unit are shown in Fig. 17. It will be noted that the distance between apertures from the bottom to the top nozzle is 36 inches and that material for each unit consists of the following parts: one ¾-inch pipe to hose fitting, ¾ by ⅜ inch reducer; six pieces of ⅜-inch pipe; one ⅜-inch hose 7 inches in length; four ⅜-inch T's; one elbow; five ⅜ by ¼-inch bushings; five ¼-inch street L's; five nipples of ¼-inch pipe; and five cyclone nozzles. Beginning at the top, the lengths for the six pieces of pipe would be approximately 2, 7, 8, 8, 3, and 3 inches. Altho the drawing indicates the lower rubber hose connection as 3 inches and the two lower pipes as 3½ and 5 inches in length, it is advisable to increase the hose length to 7 inches and to shorten each of the lower pipes to 3 inches. This is suggested to have the hose more flexible in order that the lower nozzle will not be torn loose by hitting obstructions such as stones or rough ground. The nipples of ¼-inch pipe should be about 1 inch in length. The top nozzle should be equipped with a No. 4 disc[12] and all the others with No. 3 discs.

[12] Discs for the nozzles are made with the following sized openings: No. 2, 1/82-inch; No. 2½, 5/128-inch; No. 3, 3/64-inch; No. 4, 1/16-inch; and No. 5, 5/64-inch.

TYPE B SPRAY UNIT

Plans for the construction of the type B spray unit are shown in Fig. 18. The list of materials for a single unit and their dimensions include the following: one ¾-inch pipe to hose fitting; one ¾-inch T; two ¾ by ⅜ bushings; five ⅜ inch T's; two ⅜-inch elbows; seven ⅜ by ¼ bushings; seven ¼-inch street L's; seven ¼-inch nipples 1 inch long; one ⅜-inch rubber hose 7 inches long; one bar, ¾ inch wide by $^3/_{16}$ inch thick and 23 inches long; two U-bolts; nine pieces of ⅜-inch pipe to include three pieces 11¾ inches long, one piece 15½ inches long, one piece 21½ inches long, one piece 13½ inches long, one piece 6⅛ inches long and two pieces 3 inches long. These are for the flexible connections. Seven cyclone nozzles will be needed, the two upper of which are fitted with No. 3 discs, the two next lower with No. 2½ discs, and the lower three nozzles with No. 2 discs.

MOUNTING OF SPRAY UNITS

If it were not desired to vary the distance between the spraying units, they could be mounted on the frame of a rigid, hinged or collapsible hood used on a regular vineyard sprayer. In the case of the collapsible hood used on a truck, as shown in Fig. 7, the inner unit could be attached to the bed and the outer one to the hood frame.

The ability to vary the width between the spraying units is a desirable feature. To accomplish this with the hoods mentioned in the preceding paragraph, the outer unit should be mounted on a half-boom somewhat like that shown on the right side of Fig. 16. This feed pipe could be supported on the tank in a sleeve fitted with a set screw to lock the boom at any desired width. It would be necessary to have a vertical slot in the cover to accommodate the feed pipe at the various positions needed. With the adjustable hood the spray units are mounted on the hood frame on each side. Variation in width between units is accomplished by varying the width of the hood.

SUPPORTS

An important consideration as regards the effectiveness of a spray unit is the correct height of the nozzles above ground. This will vary with the type of pruning, training, age, vigor, and variety of vines and with the height of the trellis. Usually an entire block of vines can be sprayed using only a single setting as to height, but it may be advisable to change the height when another block where conditions are dif-

ferent is treated. For this reason it is advantageous to be able to change quickly the height of the spray unit. Before 1946, the units were usually fastened to the hood frame or to the sprayer by means of U-bolts. These need not be considered because a better method has been devised.

Examination of Fig. 9 and 11 will give a general idea of the new support and of the method of attaching it to the hood frame and to the sprayer bed. The details of the support are shown in Fig. 19. Each support consists of three main parts, *viz.*, (a) a sleeve which is welded to the tie rods of the hood frame or to the bed carrying the sprayer; (b) a core which slides inside the sleeve and which is welded at right angles to a crossarm; and (c) a piece of flat iron, the crossarm, to which the spraying unit is bolted. The core and attached frame constitute the boom.

The sleeve is 1¼-inch pipe 17 inches long thru the rear side of which is drilled a $^{7}/_{16}$-inch hole ("rear" in reference to the direction in which the sprayer is driven). Over this hole is welded a ⅜-inch nut in which is placed a ⅜ by 1½-inch set screw used to hold the core at any desired height. In this position the set screw will not catch the vines. This tightener may be placed from 3 to 5 inches from the top of the sleeve. The core is a piece of boiler flue stock pipe, 1 inch in diameter and 22 inches long. This fits in the sleeve and is held at a desired height by the tightener. On the upper end of this pipe (core) is welded a piece of flat iron ⅛ by 4 by 26½ inches, the cross-piece, the two axes making a right angle. This attachment is reinforced by two ⅛ by 1 by 4 inch gussets (braces) each of which is welded to the core and to the cross-piece, as shown in Fig. 19. One end of the cross-piece is bent into a U in which the ⅜-inch pipe of one side of the spray unit is placed and held by two ¼-inch bolts. At the opposite end of the cross-piece, an L-shaped piece of flat iron is welded. Before bending, this is 4 by 2⅞ by ⅛ inches. By the addition of two ¼-inch bolts, this fork holds the ⅜-inch vertical pipe of the spray unit. The construction of all parts of the support and boom is shown in Fig. 19.

LOCATION OF SPRAY UNITS

The spraying units are located as near as possible to the center of the sides of the hood. However, this is not always possible, especially with a type of hood that covers the wheel. This may be overcome in part by mounting the hood farther forward on the sprayer frame. Regardless of the mounting of the hood, the single row nozzle spray

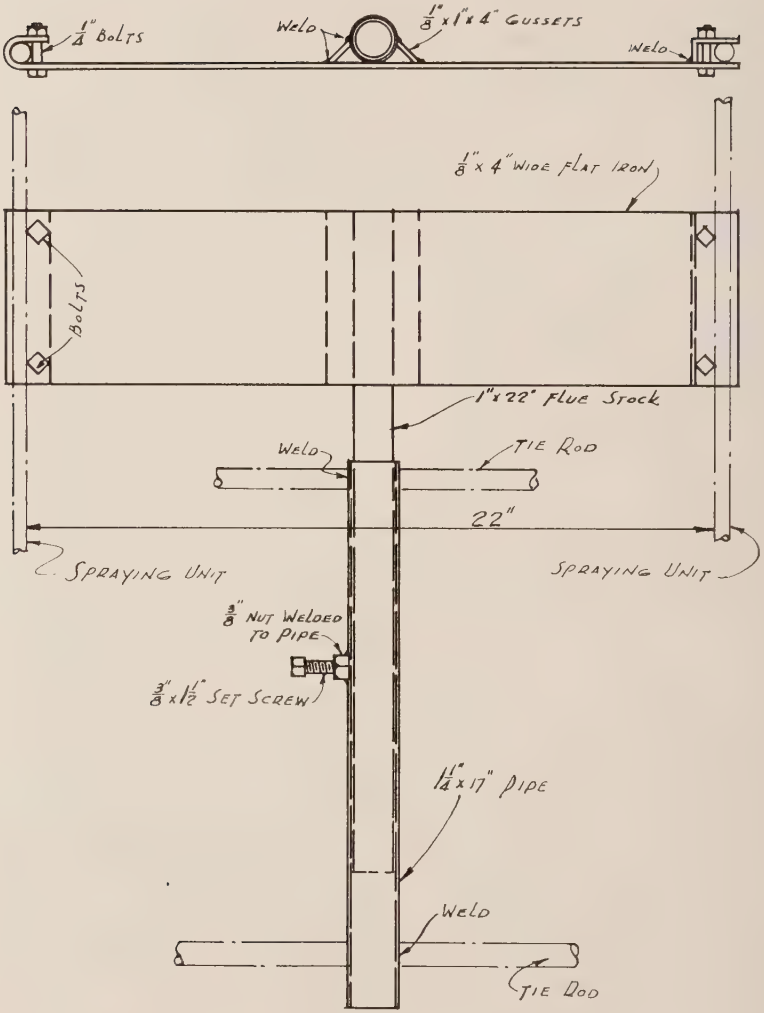

Fig. 19.—Details of adjustable support for type B spray unit.

unit, type A, should be at least 2 feet from the front of the hood. Whenever a double unit, type B, is used, the preferable location for the front row of nozzles is 2 feet from the front end frame of the hood. It may be necessary, however, to reduce this distance to 18 inches on some sprayers, as shown in Fig. 9.

Usually there is but little difficulty encountered when no guards are used to cover the nozzles. Guards may be used to prevent the vines from catching. A strip of $^{3}/_{32}$-inch sheet-iron 4 inches wide and 36 inches long could be used as a vertical guard. This protector is placed slightly ahead of each row of nozzles in order that there will be no interference with the cones of spray. It is important that the two units should be opposite each other on any sprayer; otherwise the best vortical spraying is not accomplished.

SUMMARY

The introduction of hoods to reduce the effects of the wind, which inhibits thoro spraying with unprotected fixed nozzle arrangements, was an important advance in the spraying of grapes. Since 1940 four types of hoods have been developed. The advantages and disadvantages of each type are discussed. The rigid hood is the least expensive to construct while the other hoods increase in cost to the adjustable type which is the most expensive largely because of the extra amount of skilled labor required for part of the construction. The rigid, hinged and collapsible hoods cannot be varied in width. The adjustable hood cannot only be changed in width quickly to accommodate variations in vine growth and training but can be easily closed in a few seconds for turning at the ends of the rows and for traveling outside the vineyards or thru narrow passageways. The frame of the hinged hood type enables it to pass a tall obstruction, especially in the grape row, more quickly than any of the other kinds of hoods. Other features of each type are discussed.

Detailed plans for the construction of the four types of hoods are presented, since most of these types are not on the market. All the frames are designed for construction on the farm with the addition of some special tools for all types and of some blacksmithing, machining, and welding on the hinged, collapsible and adjustable hoods. The special tools needed for construction are chiefly a pipe cutter and some form of drill press. The assistance of a sail, tent, or awning craftsman will be necessary to put metal eyelets (grommets) in the canvas cover and curtains, also to hem this heavy cloth.

About 1914, a U boom was devised for treating both sides of the row in one operation which method is designated as vortical spraying. This principle is used in all later developments of spray booms. Improvements in spraying units and their supports were made and detailed instructions are given for constructing the same.

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ABSTRACT

WIND frequently interferes with spraying the grape vines, either by entirely preventing operation at critical periods or by reducing the thoroness of the application. Hoods, which envelop the vines temporarily, nullify the effects of the wind sufficiently to permit thoro treatment. Improvements have been made in these hoods until, at present, there are four types each of which has certain advantages as well as some disadvantages over other types. The four types of hoods are discussed in this bulletin together with detailed directions for construction. This is necessary because few, if any, of these hoods are being produced commercially at the present time.

The frames of the rigid and hinged hoods can be constructed on the farm with a minimum of blacksmith and machinist operations. The collapsible hood, which may appeal to certain growers, is intermediate in cost. The adjustable hood offers many advantages over the other type but the frame requires more welding so is somewhat more expensive to build. The cover is of canvas on all types so the assistance of an awning or tent maker is needed especially to insert grommets and to hem the heavy cloth.

Improvements also have been made in the spray units, all of which are described in detail. With the exception of the nozzles, these units can be made on the farm provided pipe cutters and dies for cutting threads are available.